Top quark and Higgs Physics at Colliders

Hao Zhang

High Energy Physics Division, Argonne National Laboratory

Illinois Institute of Technology

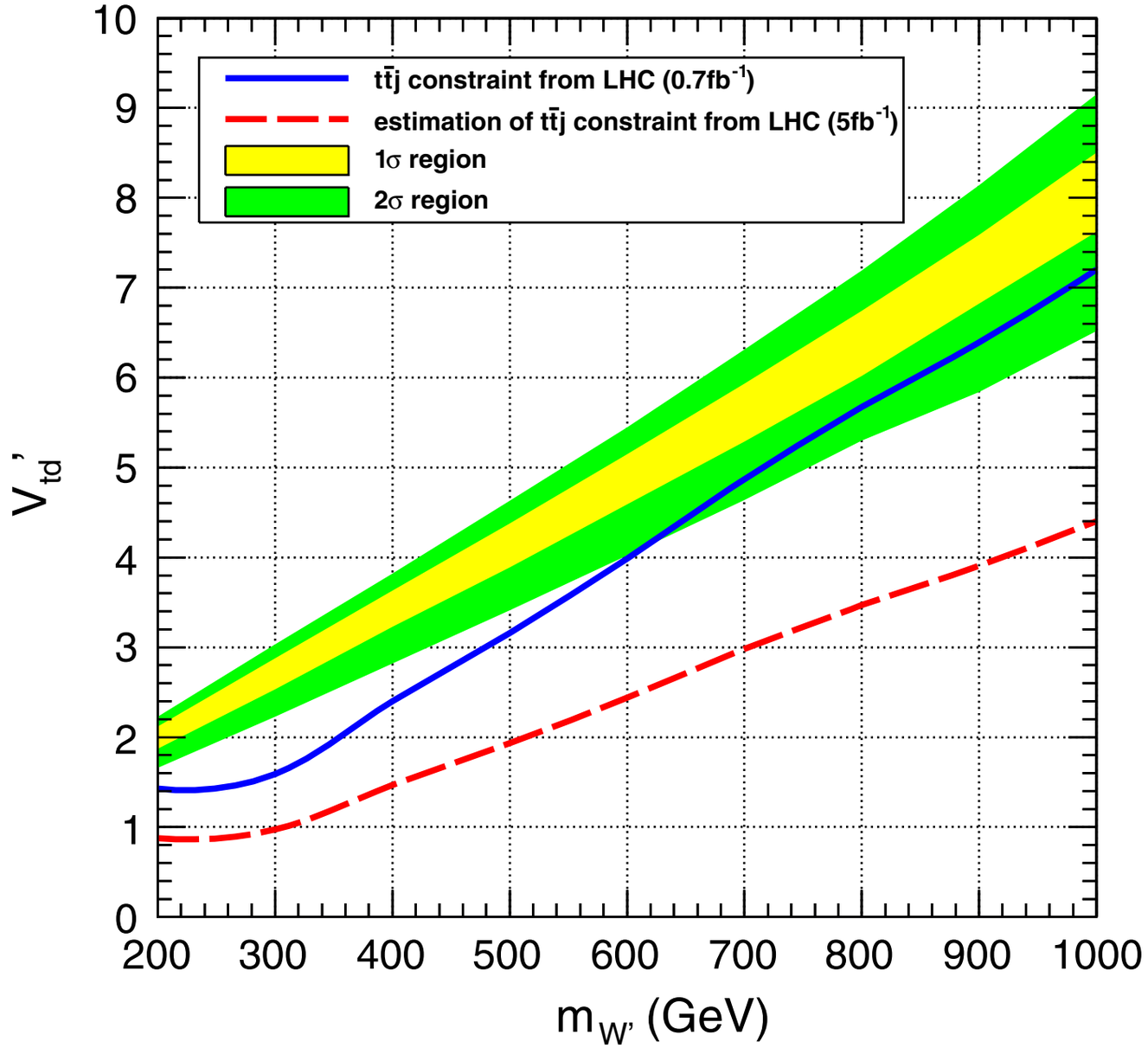
Outline

- Forward-backward asymmetry in top-quark pair production (top AFB)
  - Constraints on the flavor changing W' model
  - Top quark AFB and charged lepton asymmetry
- Top quark polarization and new physics searches
- "Fermiophobic" Higgs boson at the LHC

Top quark AFB and W' model

D Duffty, Z Sullivan, and HZ, Phys. Rev. D 85, 094027 (2012)

- We fit the top quark AFB at Tevatron using the flavor changing W' model.
- This new physics model predicts more ttbar+1jet events at the LHC.
- An exclusion bound is given in our work using early LHC data.



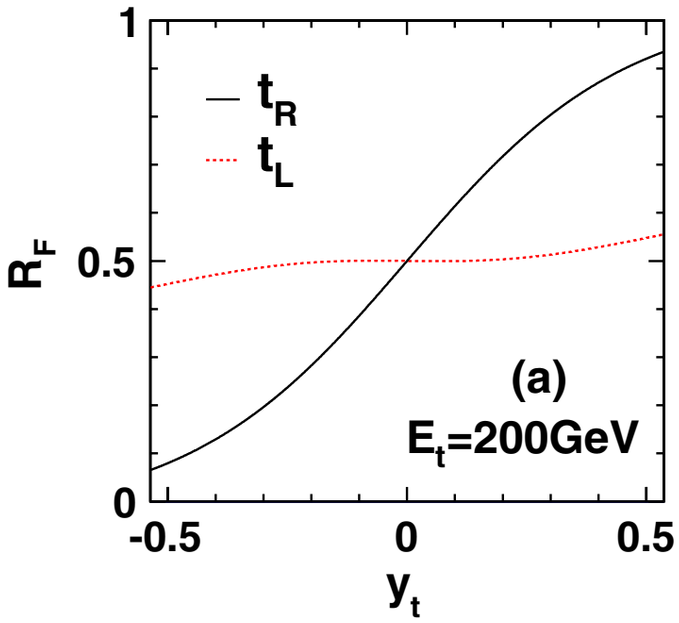
Top quark AFB and charged lepton AFB

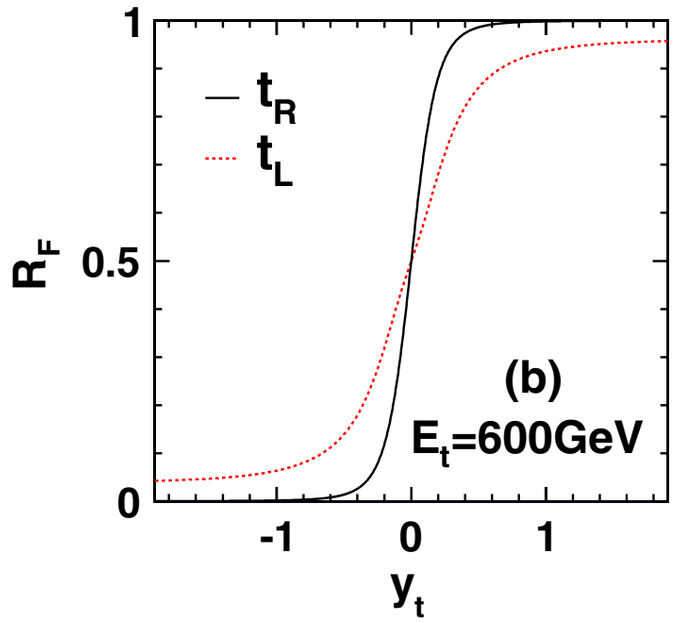
E Berger, Q.-H Cao, C.-R Chen, J.-H Yu, and HZ, Phys. Rev. Lett 108, 072002 (2012); arXiv:1111.3641; E Berger, Q.-H Cao, C.-R Chen, and HZ, arXiv:1209.4899

- Define ratio R as the number of decay leptons in forward direction as function of top quark polarization and momentum.

$$R_F^{\ell,\lambda_t}(\beta, y_t) = \frac{1}{2} + \frac{1}{2(1+\gamma^{-2}\coth^2 y_t)^{1/2}} + \frac{\lambda_t \coth^2 y_t}{4\beta\gamma^2(1+\gamma^{-2}\coth^2 y_t)^{3/2}}$$

- We investigate AFB of charged lepton from top quark decay analytically and numerically.





Top quark AFB and charged lepton AFB

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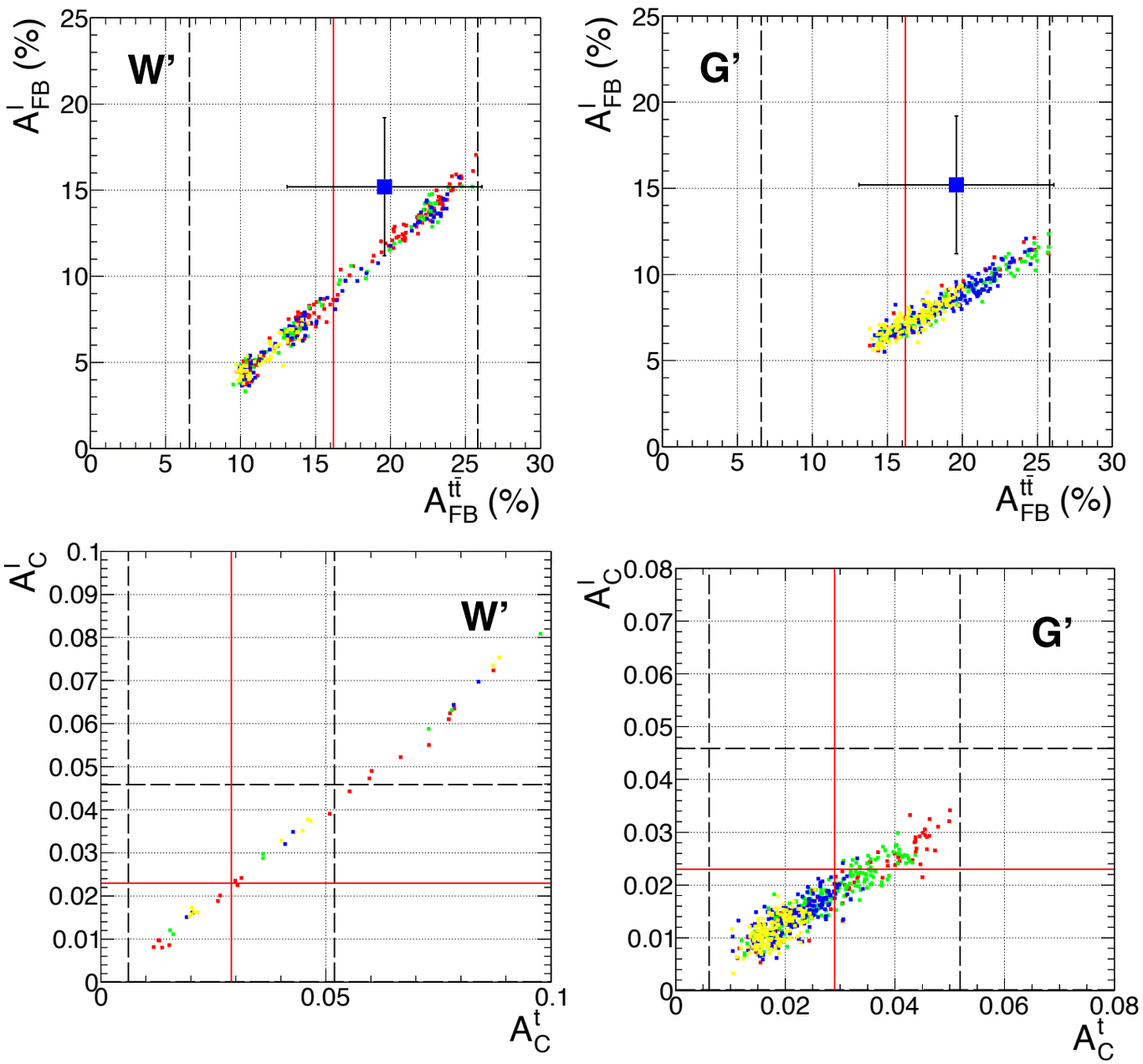
- This correlation between the top quark AFB and the charged lepton AFB can be used as a guide for model building.

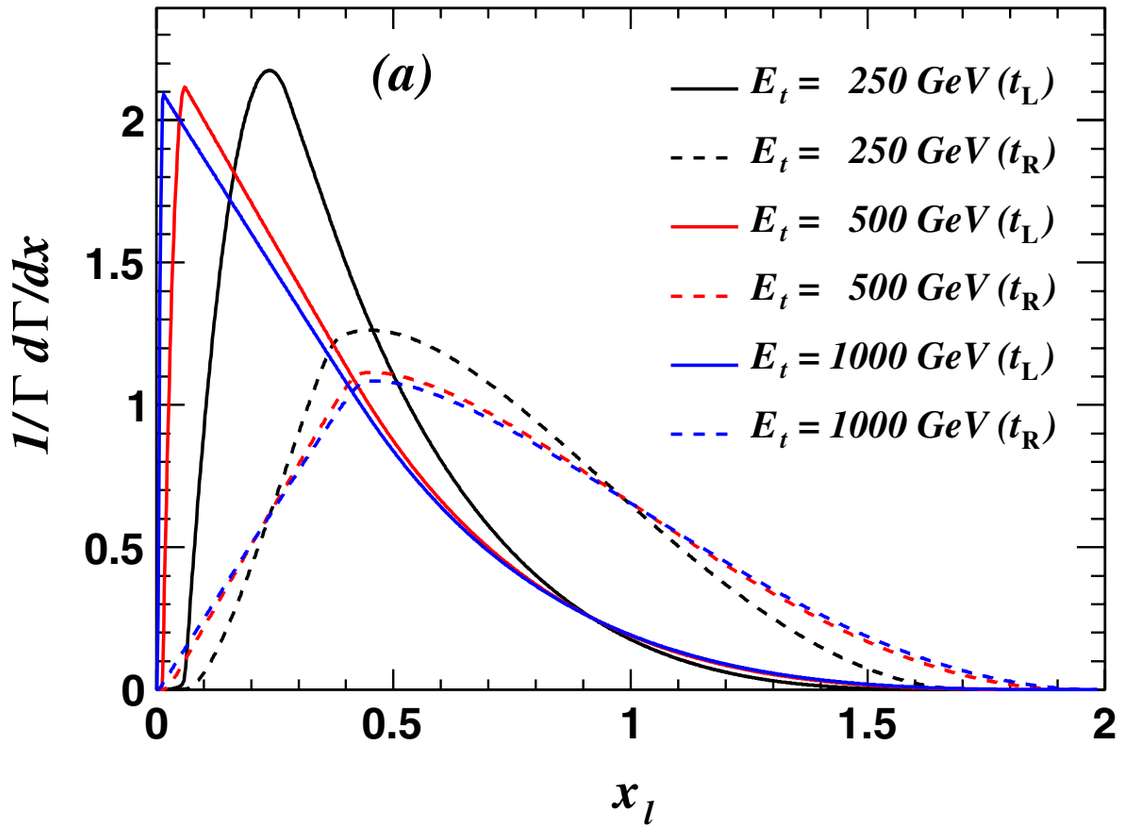
- The correlation between the top quark charge asymmetry and the charged lepton charge asymmetry has also been studied at the LHC.



Distinguish new physics models using top quark polarization

E Berger, Q.-H Cao, J.-H Yu, and HZ, Phys. Rev. Lett 109, 152004 (2012)

- Top quark polarization is a powerful tool for studying new physics models.
- Traditional method requires top quark reconstruction which is pretty hard when there is additional missing ET (dark matter) in final state.
- We show that the charged lepton energy fraction can be used to determine top quark polarization without top reconstruction.



“Fermiophobic” Higgs boson at the LHC

E Berger, Z Sullivan, and HZ, Phys. Rev. D 86, 015011 (2012)

- Higgs model with suppressed decays to fermions predicts more diphoton+dijet events than the SM.
- Although the cross section for the HV associated production is a little smaller than the VBF process, the peak of the V to dijet invariant mass distribution is a clearer smoking gun of the “fermiophobic” Higgs model.
- We simulate this channel and show that it can be used to distinguish the SM and “fermiophobic” model at the early LHC.